

## C L A I M S

What is claimed is:

1. Apparatus for generating and displaying images for determining the quality of audio reproduction in a surround sound system that produces a left total audio signal ("Lt signal") and a right total audio signal ("Rt signal"), said apparatus comprising:

(a) a left audio signal input for receiving the signal Lt;

(b) a right audio signal input for receiving the signal Rt;

(c) a display processor connected to said left and right audio inputs and having a display control output, for producing a display control signals at said output in dependence upon said signals Lt and Rt; and

(d) a graphic image display, coupled to said display control output, for displaying a two-dimensional image within an X and Y coordinate system, wherein relative in-phase components of said signals Lt and Rt are represented as positive Y coordinate points in the image, wherein relative out-of-phase components of said signals Lt and Rt are represented as negative Y coordinate

points in the image, and wherein the respective amplitudes of the signals Lt and Rt are represented as negative X and positive X coordinate points, respectively, in the image.

2. The apparatus defined in claim 1, wherein the signal Lt is comprised of signal elements unique to the left sound channel only (Lo), plus equal level and in-polarity signal elements common to both Lt and Rt (C), plus equal level but out-of-polarity signal elements common to both Lt and Rt (Surr).

3. The apparatus defined in claim 1, wherein the signal Rt is comprised of signal elements unique to the right sound channel only (Ro), plus equal level and in-polarity signal elements common to both Lt and Rt (C), minus equal level but out-of-polarity signal elements common to both Lt and Rt (-Surr).

4. The apparatus defined in claim 1, wherein the display processor calculates each X-Y coordinate point for display in accordance with the formulae:

$$Y = C + (-Surr); \text{ and}$$

$$X = -Lo + Ro; \text{ where}$$

Lo are signal elements unique to the left sound channel only, Ro are signal elements unique to the right sound channel only, C are equal level and in-polarity signal elements common to both

signals Lt and Rt, and Surr are equal level but out-of-polarity signal elements common to both signals Lt and Rt.

5. The apparatus defined in claim 1, wherein the display processor processes the signals Lt and Rt in analog form, to produce analog display control signals at said output.

6. The apparatus defined in claim 5, wherein said display processor produces an analog X coordinate control signal by summing the outputs of (1) a first full wave rectifier which is connected to the left audio signal input to receive the signal Lt and which produces a negative output signal, and (2) a second full wave rectifier which is connected to the right audio signal input to receive the signal Rt and which produces a positive output signal.

7. The apparatus defined in claim 5, wherein said display processor produces an analog Y coordinate control signal by first producing first and second intermediate signals representing the sum and difference, respectively, of the signals Lt and Rt; passing the first intermediate signal through a first full wave rectifier which produces a positive third intermediate signal; passing the second intermediate signal through a second full wave rectifier which produces a negative

fourth intermediate signal; summing the third and fourth intermediate signals to produce a fifth intermediate signal; passing the fifth intermediate signal through a first half wave rectifier to produce a positive sixth intermediate signal; passing the fifth intermediate signal through a second half wave rectifier to produce a seventh intermediate signal and summing the sixth and seventh intermediate signals.

8. The apparatus defined in claim 6, wherein the display processor further comprises a display compression generator connected to a gain control amplifier at said output to adjust the gain of the X coordinate control signal.

9. The apparatus defined in claim 7, wherein the display processor further comprises a display compression generator connected to a gain control amplifier at said output to adjust the gain of the Y coordinate control signal.

10. The apparatus defined in claim 7, wherein the display processor further comprises an amplifier connected to the output of said first half wave rectifier to increase the gain of said sixth intermediate signal.

11. The apparatus defined in claim 1, wherein the display processor samples the signals Lt and Rt at a given sampling frequency to produce digital signals and processes the digital signals in digital form to produce digital display control signals at said output.

12. The apparatus defined in claim 11, wherein the display processor samples the signals Lt and Rt at a frequency which is at least twice the maximum frequency of the the signals Lt and Rt.

13. The apparatus defined in claim 11, wherein the display processor calculates the digital X and Y coordinates of each successive point to be displayed.

14. The apparatus defined in claim 13, wherein the display processor stores a plurality of points to produce a scatter plot as a single image frame and thereafter passes said image frame to said output for display.

15. The apparatus defined in claim 14, wherein a plurality of image frames, each comprising said plurality of points, are displayed in succession to form a video image.

16. The apparatus defined in claim 14, wherein said display processor calculates the arithmetic mean point of all points in said scatter plot for which the Y coordinate is positive, and generates a first line from an origin where X and Y are both zero to said positive arithmetic mean point, for imaging on said display.

17. The apparatus defined in claim 14, wherein said display processor calculates the arithmetic mean point of all points in said scatter plot for which the Y coordinate is negative, and generates a second line from an origin where X and Y are both zero to said negative arithmetic mean point, for imaging on said display.

18. The apparatus defined in claim 16, wherein said first line is displayed in color.

19. The apparatus defined in claim 17, wherein said second line is displayed in color.